1   CLAIMS

2   What is claimed is:

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4   1.   A method for preparing a virtual three-dimensional representation of a first portion

5   of a bone comprising the steps of:

6   obtaining, from a first orientation with respect to the first portion of the bone,

7   first image data of the first portion of the bone;

8   obtaining, from a second, different orientation with respect to the first

9   portion of the bone, second image data of the first portion of the bone;

10   generating a three-dimensional (3D) virtual representation of the first portion

11   of the bone; and

12   displaying the 3D virtual representation of the first portion of the bone, the

13   displayed 3D virtual representation having an orientation, the orientation of the displayed

14   3D virtual representation being determined using at least the difference between the first

15   and second orientations from which the first and second image data were obtained.

16   2.   The method of claim 1, wherein at least one of the first and second images is a two-

17   dimensional image.

18   3.   The method of claim 2, wherein both the first and second images are two-

19   dimensional images.

20   4.   The method of claim 3, wherein at least one of the first and second images is a

21   fluoroscope image.

22   5.   The method of claim 1, comprising:

23   displaying an image of the first portion of the bone; and

24   overlaying the displayed 3D virtual representation of the first portion of the

25   bone and the image of the first portion of the bone.

26   6.   The method of claim 5, wherein the displayed image of the first portion of the bone

27   comprises at least some data from at least one of the first and second image data.

28   7.   The method of claim 5, comprising using an input device to adjust a dimension of

29   the 3D virtual representation to correspond with a dimension of the first portion of the bone.

30   8.   The method of claim 7, wherein the dimension of the first portion of the bone is a

31   diameter.

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1   9.   The method of claim 7, wherein the dimension of the first portion of the bone is a

2   length.

3   10.   The method of claim 1, wherein the displayed 3D virtual representation has a lower

4   symmetry than the first portion of the bone.

5   11.   The method of claim 10, wherein the displayed 3D virtual representation comprises

6   a cylindrical portion.

7   12.   The method of claim 5, comprising:

8   determining an intraoperative orientation of the bone; and

9   wherein the orientation of the displayed 3D virtual representation of the first

10   portion of the bone is indicative of the intraoperative orientation of the first portion of the

11   bone.

12   13.   The method of claim 5, wherein the step of determining the intraoperative position

13   of the first portion of the bone comprises:

14   securing at least one of (a) a set of energy emitters or (b) a set of energy

15   detectors to the first portion of the bone; and

16   detecting, using the set of energy detectors, energy emitted by the energy

17   emitters of the set of energy emitters.

18   14.   The method of claim 13, wherein, if the intraoperative orientation of the first portion

19   of the bone changes, updating the orientation of the displayed 3D virtual representation of

20   the first portion of the bone so that the orientation of the displayed 3D virtual representation

21   remains indicative of the intraoperative orientation of the first portion of the bone.

22   15.   The method of claim 1, comprising the steps of:

23   obtaining, from a third orientation with respect to a second portion of the

24   bone, third image data of the second portion of the bone;

25   obtaining, from a fourth, different orientation with respect to the second

26   portion of the bone, fourth image data of the first portion of the bone;

27   generating a three-dimensional (3D) virtual representation of the second

28   portion of the bone; and

29   displaying the 3D virtual representation of the second portion of the bone,

30   the displayed 3D virtual representation of the second portion of the bone having an

31   orientation, the orientation of the displayed 3D virtual representation of the second portion

1 of the bone being determined using the difference between the third and fourth orientations
2 from which the third and fourth image data were obtained.

3 16.   The method of claim 15, wherein the first and second orientations are the same as,
4 respectively, the third and fourth orientations.

5 17.   The method of claim 15, comprising:
6   displaying an image of the second portion of the bone, the displayed image
7 of the second portion of the bone comprising at least some data from at least one of the third
8 and fourth image data; and
9   overlaying the displayed 3D virtual representation of the second portion of
10 the bone and the image of the second portion of the bone.

11 18.   The method of claim 17, comprising using an input device to adjust a dimension of
12 the 3D virtual representation of the second portion of the bone to correspond with a
13 dimension of the second portion of the bone.

14 19.   The method of claim 18, wherein the dimension of the second portion of the bone is
15 a diameter.

16 20.   The method of claim 18, wherein the dimension of the second portion of the bone is
17 a length.

18 21.   The method of claim 1, wherein the displayed 3D virtual representation of the
19 second portion of the bone has a lower symmetry than the second portion of the bone.

20 22.   The method of claim 21, wherein the displayed 3D virtual representation of the
21 second portion of the bone comprises a cylindrical portion.

22 23.   The method of claim 17, comprising:
23   determining an intraoperative orientation of the second portion of the bone;
24 and
25   wherein the orientation of the displayed 3D virtual representation of the
26 second portion of the bone is indicative of the intraoperative orientation of the second
27 portion of the bone.

28 24.   The method of claim 23, wherein the step of determining the intraoperative position
29 of the second portion of the bone comprises:
30   securing at least one of (a) a set of energy emitters or (b) a set of energy

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1 detectors to the first portion of the bone;

2   detecting, using the set of energy detectors, energy emitted by the energy

3 emitters of the set of energy emitters.

4 25.   The method of claim 24, wherein, if the intraoperative orientation of the second

5 portion of the bone changes, updating the orientation of the displayed 3D virtual

6 representation of the second portion of the bone so that the orientation of the displayed 3D

7 virtual representation of the second portion of the bone remains indicative of the

8 intraoperative orientation of the second portion of the bone.

9 26.   The method of claim 23, wherein the first portion and second portions of the bone

10 are separated by a break and the method further comprises:

11   manipulating at least one of the first ands second portions of the bone with

12 respect to the other; and

13   observing the respective virtual representations of the first and second bones.

14 27.   A method for preparing a virtual three-dimensional representation of a first portion

15 of a bone comprising the steps of:

16   obtaining, from a first orientation with respect to the first portion of the bone,

17 first two-dimensional image data of the first portion of the bone;

18   obtaining, from a second, different orientation with respect to the first

19 portion of the bone, second two-dimensional image data of the first portion of the bone;

20   generating, based on at least the first and second image data, a virtual

21 representation of the first portion of the bone, the virtual representation having a lower

22 symmetry than the first portion of the bone; and

23   overlaying, on a display device, (i) an image of the virtual representation of

24 the first portion of the bone and (ii) an image of the first portion of the bone, wherein an

25 orientation of the displayed virtual representation is indicative of an intraoperative

26 orientation of the first portion of the bone.

27 28.   The method of claim 27, comprising:

28   obtaining, from a third orientation with respect to a second portion of the

29 bone, third two-dimensional image data of the second portion of the bone;

30   obtaining, from a third, different orientation with respect to the first portion

31 of the bone, fourth two-dimensional image data of the second portion of the bone;

32   generating, based on at least the second and fourth image data, a virtual

33 representation of the second portion of the bone, the virtual representation of the second

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1   portion of the bone having a lower symmetry than the second portion of the bone; and

2   overlaying, on a display device, (i) an image of the virtual representation of

3   the second portion of the bone and (ii) an image of the second portion of the bone, wherein

4   an orientation of the displayed virtual representation of the second portion of the bone is

5   indicative of an intraoperative orientation of the second portion of the bone.

6   29.   The method of claim 28, wherein the first and second orientations are the same as,

7   respectively, the third and fourth orientations.

8   30.   The method of claim 27, wherein the step of generating comprises identifying a

9   longitudinal axis of the displayed image of the first portion of the bone and wherein the

10   image of the virtual representation of the first portion of the bone extends along the

11   longitudinal axis of the displayed image of the first portion of the bone.

12   31.   A system configured to prepare a virtual three-dimensional representation of a first

13   portion of a bone, the system comprising:

14   a display device; and

15   a processor in communication with the display device, the processor

16   configured to:

17   receive first two-dimensional image data of the first portion of the

18   bone, the first two-dimensional image data having been obtained from a first orientation

19   with respect to the first portion of the bone;

20   receive second two-dimensional image data of the first portion of the

21   bone, the second two-dimensional image data having been obtained from a second, different

22   orientation with respect to the first portion of the bone;

23   generate, based on at least the first and second image data, a virtual

24   representation of the first portion of the bone, the virtual representation having a lower

25   symmetry than the first portion of the bone; and

26   overlay, on the display device, (i) an image of the virtual

27   representation of the first portion of the bone and (ii) an image of the first portion of the

28   bone, wherein an orientation of the displayed virtual representation is indicative of an

29   intraoperative orientation of the first portion of the bone.